colour drawings of the pavement which he has recently discovered in the Palace of Chuenaten at Tell el-Amarna (1400 B.C.) during his recent excavations. This pavement is quite unique in Egypt, and is especially valuable owing to the marvellous treatment of the plants depicted.

The water-colour sketches exhibited by Prof. F. W. Oliver (for the Scientific Committee of the Royal Horticultural Society) illustrated some typical examples of the damage done to plants by London fog. The injuries shown, he said, were exceedingly prevalent amongst cultivated hot-house plants in the London district during this kind of weather, and extended to a considerable distance from the metropolis, cases occurring as far as Cooper's Hill and Dorking. The sulphurous acid of the fog seemed, in many cases, to have acted directly on the living substance of the foliage and leaves, producing these lesions, while in others there seemed to have been evidence of an accumulative action of the deposits of sulphuric acid.

Mr. W. Crookes, F.R.S., who at the last *soirée* repeated some of Tesla's wonderful experiments, exhibited a novelty in the form of burning nitrogen. He employed an electric current of 65 volts and 15 amperes, alternating 130 times a second, passing it through the primary of a large induction coil. From each of the secondary poles, flames became visible, and met at the centre, being composed mainly of burning nitrogen; when the terminals were separated, so that the flames could not strike across but were in consequence extinguished, it was found that by putting them nearer together a lighted taper was sufficient to re-ignite them. The temperature of the flame exceeds slightly that of a good blowpipe, and a spectroscopic examination of the flame itself shows simply a faint and continuous spectrum. Mr. Crookes pointed out that such a method of exciting an induction coil was first employed by Mr. Spottiswoode in 1880, but "it is not known, however, that any chemical explanation of the flame has before now been published."

Mr. A. A. C. Swinton showed some very interesting photographs of electrical discharges that had been obtained by simply causing the discharges to take place across the surfaces of prepared sensitive dry plates, and consequently without the intervention of any lens. The distinctive character of the figures by the two kinds of discharges were very noticeable, so also was the evidence of their oscillatory nature.

Other electrical exhibits were:—

An ingenious device for disconnecting the supplier of electricity if a dangerous voltage happened to be established in a house, and a leakage indicator for high tension currents, both exhibited by Messrs. Drake and Gorham.

Electrical discharges over prepared surfaces, by Mr. J. Wimshurst, showing that over imperfectly conducting surfaces of large area branch-like forms of flashes are produced, and with a great difference of potential sparks of seven feet in length can be attained.

High-tension electrical apparatus, by Mr. L. Pyke, for working a considerable number of vacuum tubes from one generating source, the tubes in this case being each connected with terminally connected inductors, themselves counterpoised against two external conductors connected to the terminals of the transformer.

The Director of the Royal Gardens, Kew, exhibited a specimen of a double cocoa-nut (*Lodoicea seychellarum*), with illustrations showing its germination. This palm is tall and fan-leaved, and peculiar to two of the Seychelles Islands; its fruit weighing from 25 to 30 pounds. At the germination of the seed, "the embryo is gradually pushed out of the seed by the growth of the seed-leaf (cotyledon). One end of this remains attached to the seed, and conveys to the embryo the nutriment derived from the gradual absorption of the endosperm." Three of the drawings and a model had an additional interest in that they were made by the late Major-General Gordon.

Mr. Romanes's exhibits of living rats and rabbits attracted much attention, and would perhaps have attracted slightly more if any of the former animals had by chance got astray. They were illustrative of some of the results of experimental breeding with reference to theories of heredity. The examples clearly showed that the male and female elements did not *always* so blend together that the offspring presented characters more or less intermediate between those of the parents, but that the progeny sometimes took wholly after the father or wholly after the mother.

Another animal exhibit consisted in a living specimen of a remarkable non-venomous South African snake (*Dasypeltis scabra*), from the Zoological Society of London. This animal lives solely on birds' eggs. Each egg is swallowed whole, and by a muscular contraction of the gullet, its contents flow into the stomach, while the shell is rejected by the mouth in the form of a pellet.

Among the other exhibits we may mention the systematic and simple construction of the dark absorption bands A, B, and *a* in the solar spectrum, after Mr. Higgs's photographs, by Prof. A. S. Herschel, F.R.S.; the photographs of stellar spectra, including Nova Aurigæ, Arcturus, &c., by Mr. Norman Lockyer, F.R.S.; the photographs of leguminous plants for the determination of the fixation of free nitrogen, by Sir J. B. Lawes, Bart, F.R.S., and Dr. J. H. Gilbert, F.R.S.; and an ingenious instrument for measuring the thermal expansion of very minute solid bodies up to high temperatures, and tracing the volume charge of the silicates up to and over the interval of plasticity, by Mr. J. Joly, F.R.S.

The exhibit in the Archives Room, by the Postmaster-General, was during the whole evening thoroughly appreciated, the Telephone Company's installation being the means by which the guests were able to listen to the music of Salammbo from the grand opera at Paris. Previous to the switching on of the opera, conversation was carried on with some of the officials at the Paris end, and the accuracy with which the peculiarities of the various voices were transmitted was little short of marvellous.

The lantern demonstrations also attracted considerable attention. Mr. Saville Kent and Mr. C. V. Boys, F.R.S., as at the previous *soirée*, both showed their photographic slides, those of the former dealing with coral reefs, &c., and those of the latter with flying bullets. Mr. Norman Lockyer exhibited some photographs taken both at home and foreign Observatories, illustrative of the application of photography in astro-physical researches. The slides included some beautiful photographs of stellar spectra and solar prominences, from the Paris Observatory; of the moon and Jupiter, taken with the large Lick instrument; of the nebulosity surrounding η Argûs, photographed by Dr. Gill, F.R.S.; of the great February sun-spot, taken in India and forwarded to the Solar Physics Committee; and of the spectra of Nova Aurigæ and Arcturus, taken at Kensington. The most striking slide of all was that of the great nebula of Orion, taken by Dr. Common, F.R.S., with his five-foot reflector at Ealing. The apparent brilliancy of the stars, and the wonderful tracery in the nebulous parts, appealed to the eye not so much as an image of a slide on a screen, but as a direct view of this beautiful object through the great telescope itself. The slides shown by Mr. E. B. Poulton, F.R.S., were illustrative of the methods by which the originally opaque wings of certain butterflies and moths had become transparent and usually scaleless; numerous stages in the generation of scales were also shown.

THE FOURTH CENTENARY OF COLUMBUS.

DURING the present year great celebrations will take place in Spain, Italy, and America, in memory of Columbus and his first adventurous voyage of 1492. Although no public commemoration is arranged for in this country, the Royal Geographical Society, fully conscious of the momentous nature of that first voyage, and of the enormous expansion of geographical science which has resulted from it, set apart last Monday evening for a special Columbus meeting. The usual exhibition of maps and pictures included a number of early charts of great beauty, and a fine photograph of a contemporary portrait of Columbus, recently made known by Mr. Markham. The paper of the evening, read by Mr. Clements Markham, C.B., F.R.S., was occupied with an account of recent discoveries with regard to Columbus, and the correction of many erroneous ideas widely entertained until now. As a critical summary of perhaps one of the most difficult branches of research—that into the actual life of a popular hero enhaloed with centuries of tradition—this paper is of great value. An abstract of it, and of the appendices on other fifteenth century explorers, is given below.

Much new light has been thrown upon the birth and early life of Columbus of late years by the careful examination of monastic and notarial records at Genoa and Savona.

There is no doubt as to the birthplace of Columbus. His father was a wool-weaver of Genoa, whose house was in the Vico Dritto di Ponticelli, which leads from the gate of San

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Andrea to the church of S. Stefano. It was battered down during the bombardment of Genoa in the time of Louis XIV., was rebuilt with two additional stories, and is now the property of the city of Genoa.

Here Columbus was born, the date of his birth being fixed by three statements of his own, and by a justifiable inference from the notarial records. He said that he went to sea at the age of fourteen, and that when he came to Spain in 1485 he had led a sailor's life for twenty-three years. He was, therefore, born in 1447. The authorities who assign 1436 as the year of his birth rely exclusively on the guess of a Spanish priest, Dr. Bernaldez, Cura of Palacios, who made the great discoverer's acquaintance towards the end of his career.

The notarial records, combined with incidental statements of Columbus himself, also tell us that he was brought up, with his brothers and sister, in the Vico Dritto at Genoa; that he worked at his father's trade and became a "lanerio," or wool-weaver; that he moved with his father and mother to Savona in 1472; and that the last document connecting Cristofero Colombo with Italy is dated on August 7, 1473. But in spite of his regular business as a weaver, he first went to sea in 1461, at the age of fourteen, and he continued to make frequent voyages in the Mediterranean and the Archipelago—certainly as far as Chios.

When Columbus submitted his proposition for an Atlantic voyage to the Spanish sovereigns, they referred it to a committee, presided over by Father Talavera, which sat at Cordova, and condemned it as impracticable. It is generally supposed that the proposals of the Genoese were subsequently submitted to an assembly of learned persons at the University of Salamanca, and again condemned. The truth was quite different. Columbus was gifted with a charming manner, simple eloquence, and great powers of clear exposition. It was an intellectual treat to hear him recount his experiences, and the arguments for his scheme. Among those who first took an interest in his conversation, and then became a sincere and zealous friend, was the Prior of the great Dominican Convent of San Estevan, and Professor of Theology at Salamanca, who shrewdly foresaw that the most effectual way of befriending Columbus would be by affording ample opportunities of discussing the questions he raised. For this object there could be no better place than the University of Salamanca, where numerous learned persons were assembled, and where the Court was to pass the winter. The good Prior lodged his guest in a country farm belonging to the Dominicans, called Valcuebo, a few miles outside Salamanca. Hither the Dominican monks came to converse on the great deductions he had drawn from the study of scientific books, and from his vast experience, discussing the reconciliation of his views with orthodox theology. Later, in the winter, Columbus came into the city and held conferences with men of learning, at which numerous courtiers were present. These assembages for discussion—sometimes in the quiet shades of Valcuebo, sometimes in the great hall of the convent—excited much interest among the students and at Court. The result was, that the illustrious Genoese secured many powerful friends at Court, who turned the scale in his favour when the crucial time arrived. Such is the slight basis on which the story of the official decision of the Salamanca University against Columbus rests.

Captain Duro, of the Spanish Navy, has investigated all questions relating to the ships of the Columbian period and their equipment with great care; and the learning he has brought to bear on the subject has produced very interesting results. The two small caravels provided for the voyage of Columbus by the town of Palos were only partially decked. The *Pinta* was strongly built, and was originally lateen-rigged on all three masts, and she was the fastest sailer in the expedition; but she was only 50 tons burden, with a complement of eighteen men. The *Niña*, so-called after the Niño family of Palos, who owned her, was still smaller, being only 40 tons. The third vessel was much larger, and did not belong to Palos. She was called a "nao," or ship, and was of about 100 tons burden, completely decked, with a high poop and forecastle. Her length has been variously estimated. Two of her masts had square sails, the mizen being lateen-rigged. The crew of the ship *Santa Maria* numbered fifty-two men all told, including the admiral.

Friday, August 3, 1492, when the three little vessels sailed over the bar of Saltes, was a memorable day in the world's history. It had been prepared for by many years of study and labour, by long years of disappointment and anxiety, rewarded at length by success. The proof was to be made at last. To the incidents of that famous voyage nothing can be added. But we may at least settle the long-disputed question of the landfall of Columbus. It is certainly an important one, but it is by no means a case for the learning and erudition of Navarretes, Humboldts, and Varnhagens. It is a sailor's question. If the materials from the journal were placed in the hands of any midshipman in Her Majesty's Navy, he would put his finger on the true landfall within half an hour. When sailors such as Admiral Becher, of the Hydrographic Office, and Lieutenant Murdoch, of the United States Navy, took the matter in hand, they did so. Our lamented associate, Mr. R. H. Major, read a paper on this interesting subject on May 8, 1871, in which he proved conclusively by two lines of argument that Watling Island was the Guanahani or San Salvador of Columbus.

The spot where Columbus first landed in the New World is the eastern end of the south side of Watling Island. This has been established by the arguments of Major, and by the calculations of Murdoch, beyond all controversy. The evidence is overwhelming. Watling Island answers to every requirement and every test, whether based on the admiral's description of the island itself, on the courses and distances thence to Cuba, or on the evidence of early maps. We have thus reached a final and satisfactory conclusion, and we can look back on that momentous event in the world's history with the certainty that we know the exact spot on which it occurred—on which Columbus touched the land when he sprang from his boat with the standard waving over his head.

The discoveries of Columbus, during his first voyage, as recorded in his journal, included part of the north coast of Cuba, and the whole of the north coast of Española. The journal shows the care with which the navigation was conducted, how observations for latitude were taken, how the coasts were laid down—every promontory and bay receiving a name—and with what diligence each new feature of the land and its inhabitants was examined and recorded. The genius of Columbus would not have been of the same service to mankind if it had not been combined with great capacity for taking trouble, and with habits of order and accuracy.

Columbus regularly observed for latitude with Martin Behaim's astrolabe or the earlier quadrant, when the weather rendered it possible, and he occasionally attempted to find the longitude by observing eclipses of the moon with the aid of tables calculated by old Regiomontanus, whose declination tables also enabled the admiral to work out his meridian altitudes. But the explorer's main reliance was on the skill and care with which he calculated his dead reckoning, watching every sign offered by sea and sky by day and night, allowing for currents, for leeway, for every cause that could affect the movement of his ship, noting with infinite pains the bearings and the variation of his compass, and constantly recording all phenomena on his card and in his journal. Columbus was the true father of what we call proper pilotage.

On his return his spirit of investigation led him to try the possibility of making a passage in the teeth of the trade wind. It was a long voyage, and his people were reduced to the last extremity, even threatening to eat the Indians who were on board. One night, to the surprise of all the company, the admiral gave the order to shorten sail. Next morning, at dawn, Cape St. Vincent was in sight. This is a most remarkable proof of the care with which his reckoning must have been kept, and of his consummate skill as a navigator.

In criticizing the Cantino map showing Cortoreal's coastlines, Mr. Markham showed that absurd mistakes had been made, not by the voyager or his pilots, but by the cartographer, and subsequent commentators. Vespucci's description of his "first voyage" in 1797, was subjected to very thorough criticism, and shown, in spite of the arguments of authors who have tried to support the veracity of that ingenious romancer, to have been a pure fabrication. Little or no credit could be given to Vespucci in any case, as he was forty-eight years old on first going to sea, and in those days apprenticeship from boyhood was indispensable for a knowledge of seamanship.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The Science Examiners have issued the following Class Lists:—

Chemistry.—First Class: C. L. Fort (New) R. E. Hughes

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